



Prevalence of Cholelithiasis among Patients with Occupational Pulmonary Pathology and Patients with Vibrational Disease

Vasiliy D. Fedotov^{1,2*}, Igor A. Makarov¹, Natalia V. Mokeeva¹
and Irina S. Dobrotina²

¹Department of Clinic, Research Institute for Hygiene and Occupational Pathology, Nizhny Novgorod, Russian Federation.

²Department of Hospital Therapy, Nizhny Novgorod State Medical Academy, Nizhny Novgorod, Russian Federation.

Authors' contributions

This work was carried out in collaboration between all authors. Author IAM designed the study, wrote the protocol and wrote the first draft of the manuscript. Author VDF managed the literature searches and manuscript editing. Authors NVM and ISD did the manuscript review. All authors read and approved the final manuscript.

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ABSTRACT

Objective: Cholelithiasis is one of the topical issues of the modern medical science. The aim of the study was to discover the prevalence of cholelithiasis among patients with occupational COPD and vibrational disease.

Methods: We monitored 1331 patients with chronic occupational pathology. 410 of them were engaged in mechanical engineering and were affected by occupational COPD, 327 patients with vibrational disease from the same type of manufacturing, and 594 metal workers and clinchers with vibrational disease but engaged in aircraft industry. This study followed the ethical criteria recommended by the Resolution N 248 of 14.08.1998 of Ministry of Health of the Russian Federation.

*Corresponding author: E-mail: basil11@yandex.ru;

Results: The highest incidence rate of cholelithiasis development was registered among patients with pulmonary pathology (23.6% of women and 14.4% of men). The least incidence rate was registered among patients occupied in foundry engineering (4.5% of women, 0.5% of men).

Conclusions: The possible cause of incidence rate of cholelithiasis development reduction among patients with vibrational disease is the absence of hypoxaemia and systemic inflammation. The second essential aspect is that the vibrational influence on bile prevents aggregation of bile components into calculi.

Keywords: Chronic obstructive pulmonary disease; vibration disease; cholelithiasis.

1. INTRODUCTION

One of the topical issues of the modern medical science is gallstone disease or cholelithiasis. Basing on the prevalence rate, this pathology ranks the third place after cardiovascular diseases and diabetes [1]. Thus, in the USA 10% of the general population is diagnosed with cholelithiasis. In this respect the detection rate of the disease escalates with age: among the child population the prevalence equals approximately 5%¹⁾, after reaching the age of 40 years 20% of examined patients are diagnosed with the disease, after 70 years there are 30% diagnosed [2]. The statistics on the prevalence of the cholelithiasis in Russia are highly discrepant. So, according to Ilichenko A. A., the prevalence of cholelithiasis in our country ranges from 3% to 12% [1] of the different examined cohorts. At the same time, Maksimov VA [3] mentions 15%. According to Skvortsova TE, et al. [4] the prevalence of cholelithiasis in different regions of Russia ranges from 5 to 25%. Endemic character of the disease and the necessity of surgical treatment reclassify cholelithiasis from a medical category to the category of socioeconomic problems. For instance, solely in the USA about half a million of cholecystectomy are undertaken yearly. In Russia there were 340 000 cholecystectomies performed yearly till 2012. At present there are 500 000 cholecystectomies performed every year [5].

According to the opinion of the majority of researchers, women have cholelithiasis 3-4 times more often than men [1,3]. However, several authors claim that the prevalence of cholelithiasis becomes practically identical among women and men after they reach 50 years of age [6].

It is assumed that several factors affect the appearance of gallstones in gallbladder: Sex, ethnic affiliation, genetic predisposition, body weight [3] and, as stated above, age. At the same time in contemporary medical literature there is an opinion that incidence of cholelithiasis

is mostly often associated with metabolic disorders: 17.6% of patients with diabetes mellitus suffer from cholelithiasis; 100% of patients suffering from 3rd or 4th degree obesity have cholelithiasis [7].

It is known that one of the clinical features of chronic obstructive pulmonary disease (COPD) is its persistently evolving character and combinations of a variety of concurrent, comorbid pathologies. Numerous researches by both foreign and national authors demonstrate that chronic pathology of respiratory system in 85% of cases is associated with essential hypertension, in 39% – with obesity, in 67% - with osteoporosis, etc. At that, “extrapulmonary” manifestations of COPD are connected with the presence of chronic systemic inflammation and hypoxia [8].

Shoikhet I and Klester EB [9] (who monitored 1104 patients with COPD) specify that these patients are more often diagnosed with a gastrointestinal pathology, which includes Helicobacter pylori gastritis, atrophic gastritis, gastroduodenal ulcer and gastroesophageal reflux disease. Siva R, et al. [10], detected a clear correlation between COPD and gastric ulcer.

However, contemporary medical literature lacks data on correlation between COPD and hepatobiliary pathology. Therefore, the present research was undertaken to specificate the prevalence of pathology in hepatobiliary system of patients with occupational COPD and vibrational disease.

2. SUBJECTS AND METHODS

This study followed the ethical criteria recommended by the Resolution N 248 of 14.08.1998 of Ministry of Health of the Russian Federation. All patients received an explanation about the study and gave consent by participating in the study.

Data on three groups of patients were studied (1331 people in all), who were inspected in the clinic of Rospotrebnadzor FBSI NNRIHOP from 2002 to 2014. The first (major) group consisted of 410 patients (average age – 55.0 ± 7.7 , body mass index – (BMI) 30.8 ± 5.8): 195 women (BMI 33.2 ± 6.0) and 215 men (BMI 28.0 ± 4.8), involved in foundry production with occupational COPD at different severity level and with duration of the disease from 6 to 12 years. The surveyed individuals of this group were exposed to siliceous dust of high concentrations (time weighted averages of concentration reached more than 10 mg/m^3) and noise (at an average, exceeding maximum permissible conditions by 5 dB).

Two other comparison groups consisted of patients who suffered from vibrational disease and occupational osteoarthritis.

The first comparison group (group №2) consisted of 327 patients (average age 58.2 ± 8.1 , BMI 28.4 ± 5.2): 164 women (BMI 30.7 ± 5.4) and 163 men (BMI 26.2 ± 3.5). The group included fettlers and polishers in foundry production, who were exposed to physical factors (local vibration approximately 115 dB and excess of maximum acceptable noise level), physical overload and air pollutants of foundry production in concentrations insignificantly over occupational exposure limit.

The second comparison group (group №3) consisted of 594 patients (average age 59.8 ± 7.5 , BMI 27.0 ± 4.6): 202 women (BMI 29.2 ± 5.1) and 392 men (BMI 25.9 ± 4.0), assemblers and clinchers in an aircraft plant, who were subjected to the exposure of combined vibration (local and whole-body vibration approximately 126-130 dB) and noise level exceeding maximum acceptable.

Apparently, the major and the comparison groups differed in severity of exposure to vibration and in presence of air pollutants. Standard clinical and laboratory examination was carried out for all the patients. Cholelithiasis was detected per ultrasound testing of abdominal organs.

The obtained data were statistically processed by the means of the Statistical 6.0 software. The distribution pattern was determined by Kolmogorov-Smirnov test. At the approximately normal distribution, during the data specification, the mean value (M) and error of mean (m) were applied in the format $M \pm m$. The difference between proportions was evaluated according to

Yates continuity-corrected χ^2 test in contingency tables 2×2 .

3. RESULTS

In the group №1 cholelithiasis was detected in 77 cases (19%) (46 women (23.6%) and 31 men (14.4%)) with chronic occupational pulmonary disease. The age of gallstone discovery among women and men of the group №1 was 51.9 ± 1.5 and 51.0 ± 1.5 correspondingly and it did not differ statistically.

Along with this, conspicuous is the fact that cholelithiasis is more severe among the women of the group №1, which is positively indicative of a more frequent surgical emergency (66% against 29%, $\chi^2 = 10.07$, $p = 0.0015$). Men with occupational pulmonary pathology in most cases harbour gallstones asymptotically. Though men have a tendency to an earlier cholecystectomy: Correspondingly at 51.0 ± 1.5 years against 52.7 ± 1.4 among women.

In the group №2 32 patients (9.8%) were diagnosed with cholelithiasis, which indicates a significantly lower degree of incidence of cholelithiasis in population basing on the data of the majority of researchers (20%) ($\chi^2 = 21.32187$, $p = 0.000004$). Among 164 women of this group 24 were diagnosed with cholelithiasis (14.6%), 18 of them underwent cholecystectomy, 6 had gallstones. Among 163 men from the group №2 only 8 had cholelithiasis (4.9%), 5 of them underwent the surgery, 3 had persisting cholelithiasis. As is obvious, in this group cholelithiasis was more frequent among women than men ($\chi^2=6.25$, $p=0.012$), which correlates the literature data.

In the group №3 cholelithiasis was detected in 11 cases, i.e., prevalence of cholelithiasis was statistically significantly lower in comparison with population (1.85%, against 20%; $\chi^2=122.273$, $p=0.0000001$).

Only 9 women (4.5%) from this group had cholelithiasis (among 202), 5 underwent cholecystectomy, 4 had gallstones. Only 2 men from this group had cholelithiasis (among 392), 1 patient had the surgery, therefore, 1 had gallstones.

By comparison of the cholelithiasis detection rate a statistically significant difference was discovered among men and women of this group ($\chi^2=8.87$, $p=0.0029$). Cholelithiasis was found

more frequent among the women, though they were considerably less in number than men. By the comparison of the three groups basing on prevalence of cholelithiasis a statistically significant difference was revealed between the group №1 and the other two (№1-№2 $\chi^2=8.16$, $p=0.0043$, №1-№3; $\chi^2=69.43$, $p=0.00001$). Therefore, patients with COPD had cholelithiasis notably more often than patients with vibrational disease.

4. DISCUSSION

The acquired data on the detection of cholelithiasis in the group №1 did not differ from the prevalence of this pathology among middle-aged patients basing on the data by Skvortsova T. A. ⁴⁾ ($\chi^2=0.381$, $p=0.826$), but positively higher than the data by Maksimova VA. [3] and Ilchenko AA. [1] ($\chi^2=5.642$, $p=0.017$). Moreover, propensity of the patients of this group to obesity is conspicuous, which is confirmed by the literature data about the connection of COPD and metabolic syndrome.

It is a well-known fact that women possess a greater susceptibility to gallstones formation which is caused by female constitutional peculiarities. Nevertheless, the data resulting from the present research differ slightly from the provided data in the literature. Thus, Maksimov VA [3] asserts that women suffer from cholelithiasis four times more often than men. Among our patients there was no significant statistical difference between the sexes ($\chi^2=3.37$, $p=0.066$), which corresponds to the data obtained by Polunina TE [6].

Statistically significant reduction of cholelithiasis prevalence among patients without pulmonary pathology, as well as similar incidence of cholelithiasis among men and women in the group №1 is circumstantial but still rather convincing evidence of the connection between this pathology and COPD.

As seen, the resulting data received during the present research do not vary from the literature data and confirm the fact that cholelithiasis in most of the cases is a malady of middle-aged population. Thus, almost 70% of patients with chronic pulmonary pathology and concurrent cholelithiasis are women of menopausal age or after an invasive surgical gynecological intervention. Men as well are of no young age.

Thus, our research confirmed the literature data that one of the main causes of cholelithiasis is

increased body mass [11] (BMI of group №1 30.8 ± 5.8).

We assume that the probable mechanism of stone formation in the gallbladder of patients with occupational COPD resides in combination of major pathophysiological manifestations of this pathology: hypoxaemia and systemic inflammation, late onset hypogonadism. According to the literature data one of the possible pathogenic mechanisms of cholelithiasis formation among occupational pulmonary patients may cause hypoxaemia of bone tissue [12,13], which is complemented with osteopathy and decalcification [14,15]. And osteoporosis in its turn is considered to be a risk factor for gallstone disease [16]. However, according to the literature data, most of gallstones consist of cholesterol (80-90%), and only 10-20% of stones consist of black and brown pigment [4]. The chemical composition of our patients' gallstones was not studied in this research and it is impossible to determine the influence of calcium and lipid metabolism disorder in the process of gallstone formation.

Nevertheless, to confirm the hypothesis about the connection between COPD and gallbladder disease there were two comparison groups monitored: The risk of COPD development was minimal in the first one and was fully excluded in the second one. A significant difference of cholelithiasis incidence rate in the second comparison group not only from the major one but also from the first comparison group, is, probably, determined both by absence of air pollutants and a more powerful vibrational impact on a worker's organism, in consequence of which there was no biliary sludge forming in the gallbladder.

5. CONCLUSION

Therefore, we are inclined to conceive that the risk of cholelithiasis development among patients with various occupational pathologies is significantly diverse, moreover, cholelithiasis may be considered to be a comorbid of COPD. Pathogenic mechanisms of cholelithiasis formation with occupational COPD are different from such with a vibrational disease and warrant further study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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